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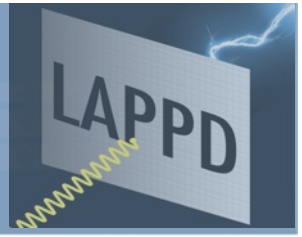


# Integration of LAPPD Electronics in MCP Testing at the APS

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# Goals of Electronics Integration Effort at APS

**To further the electronics development:**

- **Proof of principles**
  - **demonstrate working PSEC4 chip**
  - **demonstrate complete end-to-end prototype of front-end electronics - analog card -> digital card -> central card ->stored data**
- **Work out the kinks**
- **Algorithm development**
- **Comparison against control data (taken with scope)**

**To further the MCP testing effort:**
**Capitalize on the advantages of the PSEC4-based electronics**

- **Ability to store and analyze >4 readout channels**
- **Nice dynamic range and signal-to-noise properties of PSEC4**

# Software and Algorithm Development

## Two sets of tools:

- Matlab-based
  - Most up-to-date algorithms for pulse selection and integration
  - Potentially compatible with Jean-Francois' code
- Python based
  - Uses libraries of Matlab functions but does require Matlab. It has the advantage of being light and stand-alone
  - Ultimately more compatible with interactive use of the electronics.

**Both code sets ultimately produce a text format for which there ROOT scripts for plot making.**

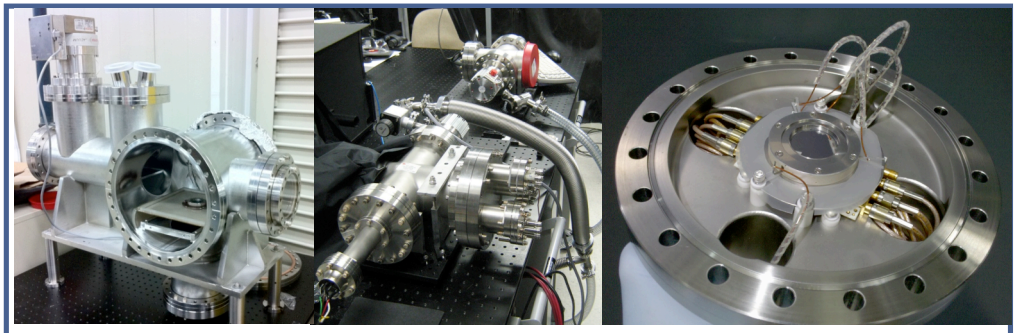
## Code is available through svn:

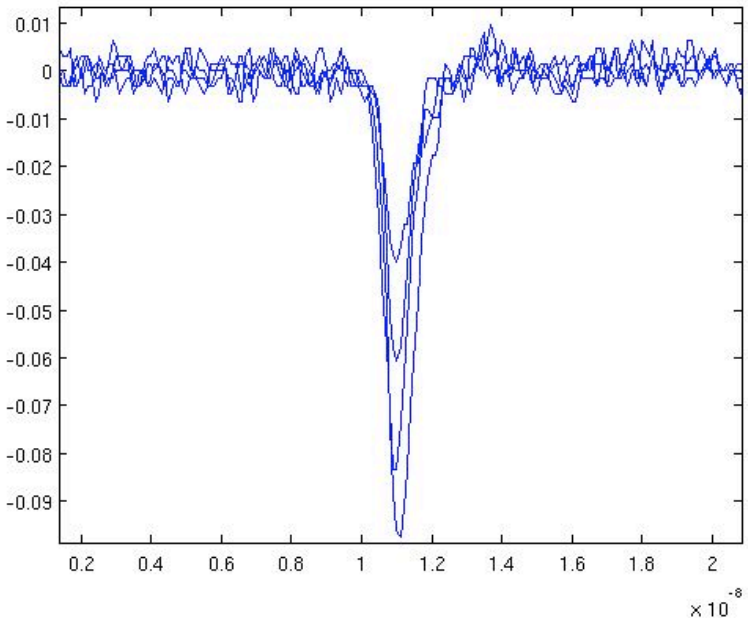
https://lappd-trac.uchicago.edu/browser/LAPPD/software/mcp_analysis
https://lappd-trac.uchicago.edu/browser/LAPPD/software/rootanalysis

## Data is available on:

/psec/data1/APS8inchTests/
/psec/data1/APS33mmTests/
/psec/data1/APS8demountableTests/

# Hardware






- **Fast, pulsed UV laser**
- **2 vacuum chambers and facilities for testing sealed glass tiles**
- **Capability for scope and chip based readout**

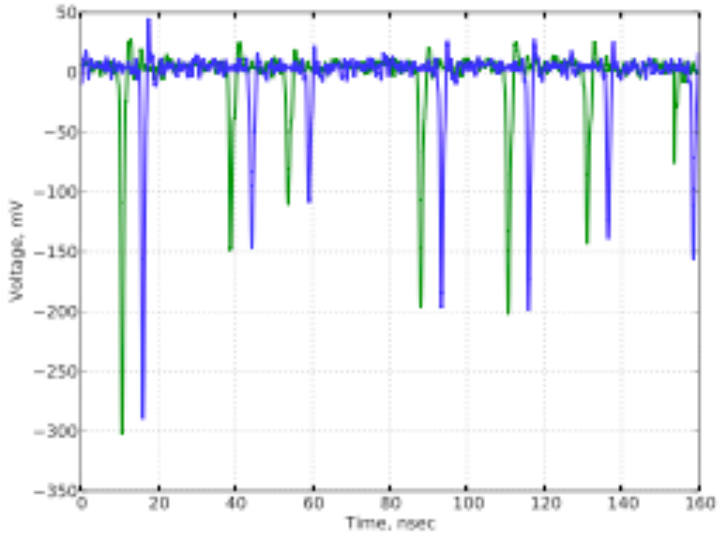
# scope-in-a-box

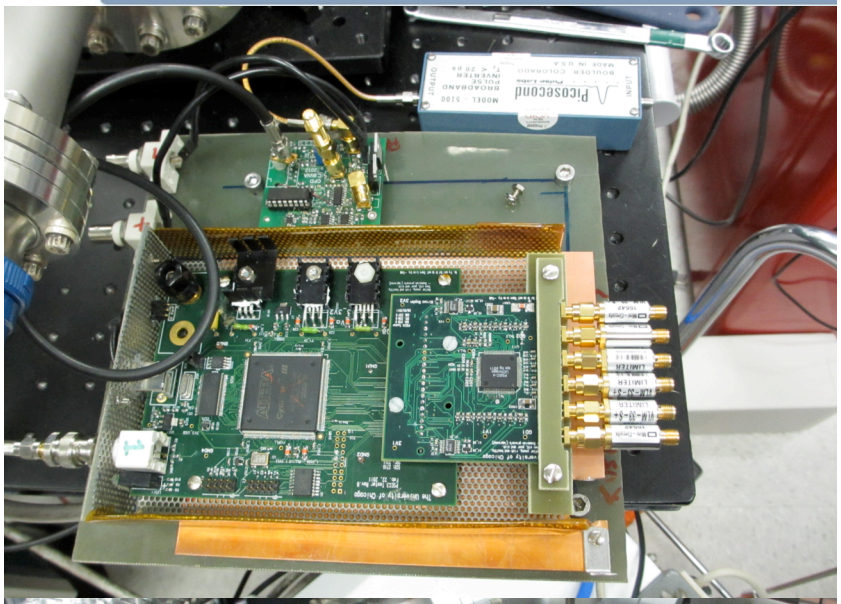
**We are now able to test the psec4 chip integrated with our detector system.**

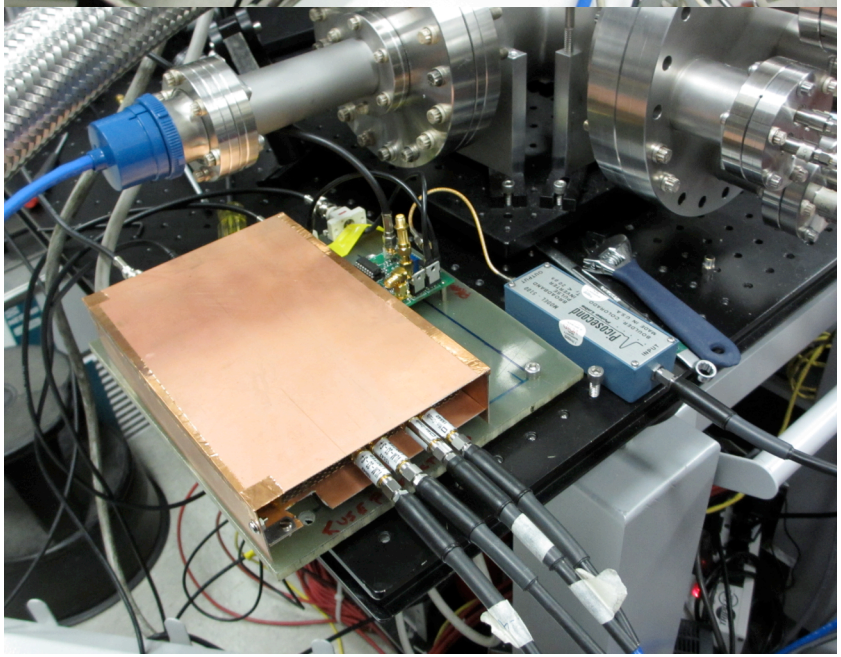
**Scope-in-a-box is a six channel oscilloscope, built around our psec4 chip and digital electronics.**

**We also have scripts to convert these data into our matlab format.**

**But, we still haven't systematically used the SiAB as a replacement for the actual scope.**



# Trigger Problems

**Main operational problem we ran into was a lack of adequate trigger option.**

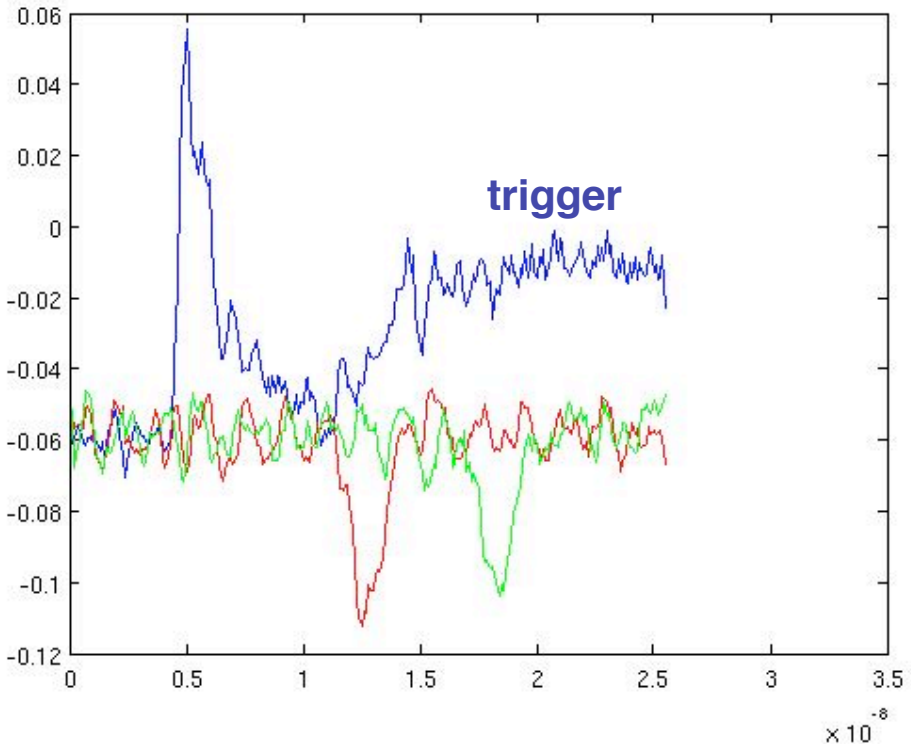
**Trigger was unstable, sensitive to RF noise and slow.**

**Any absolute timing measurements require us to record the scope trace within the data stream.**

**Timing of the "digital card" is different and jitters wrt the PSEC chip.**

**Have to deal with wrap-around of the data.**

**Eric recently got self-triggering to work. We're looking forward to trying it out.**



# Pokels Cell noise

**RF from the pokels cell in the laser produces noise on our readout.**

**Noise frequency overlaps with that of the actual pulses.**

**Could be shielded but not easy or cheap.**

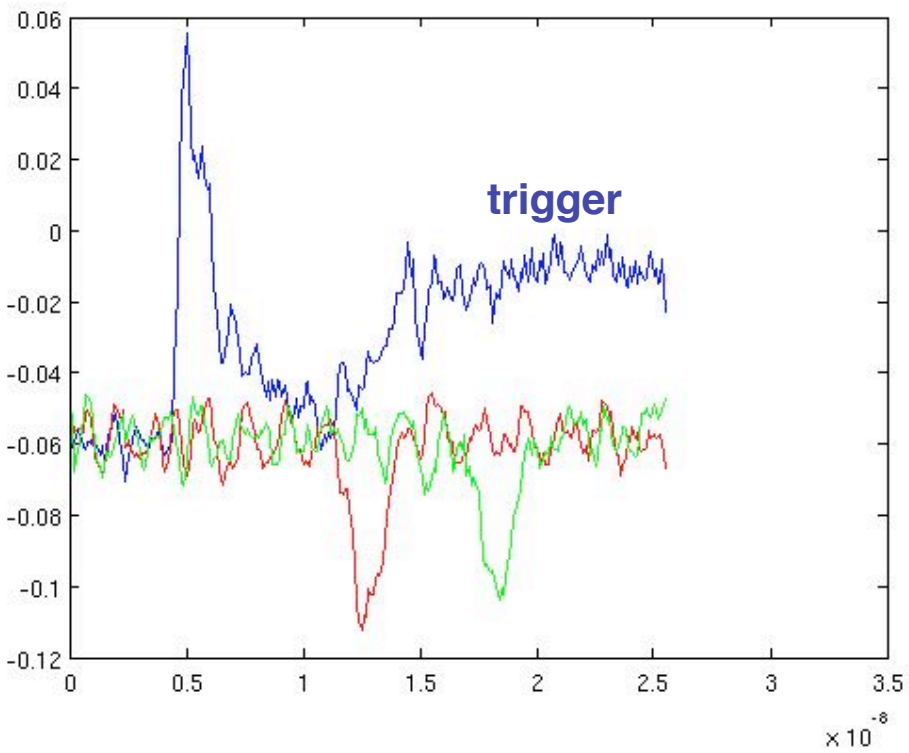
**Optical delays are not feasible.**

**The majority of the oscillatory noise is probably due to ground loops.**

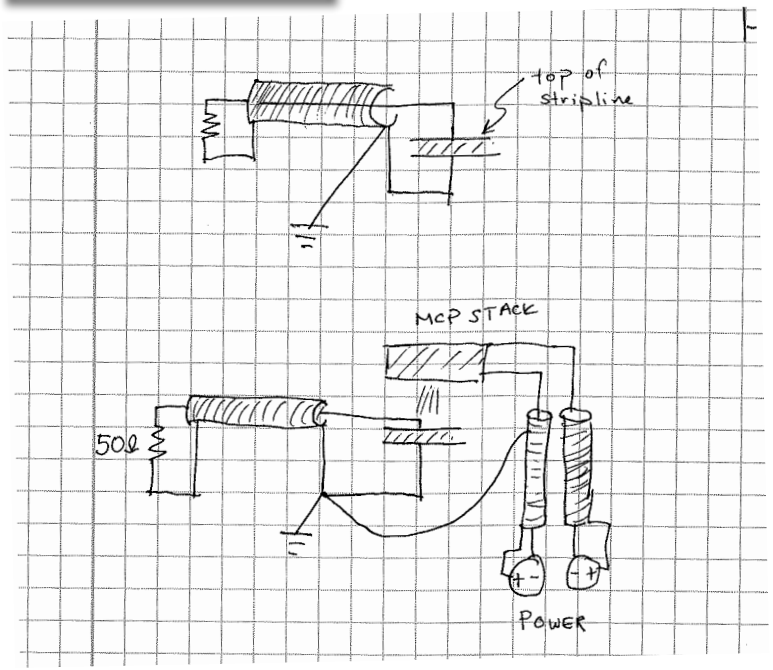
**Inductances on the HV largely solved the problem on the 8” and 33mm chambers with scope.**

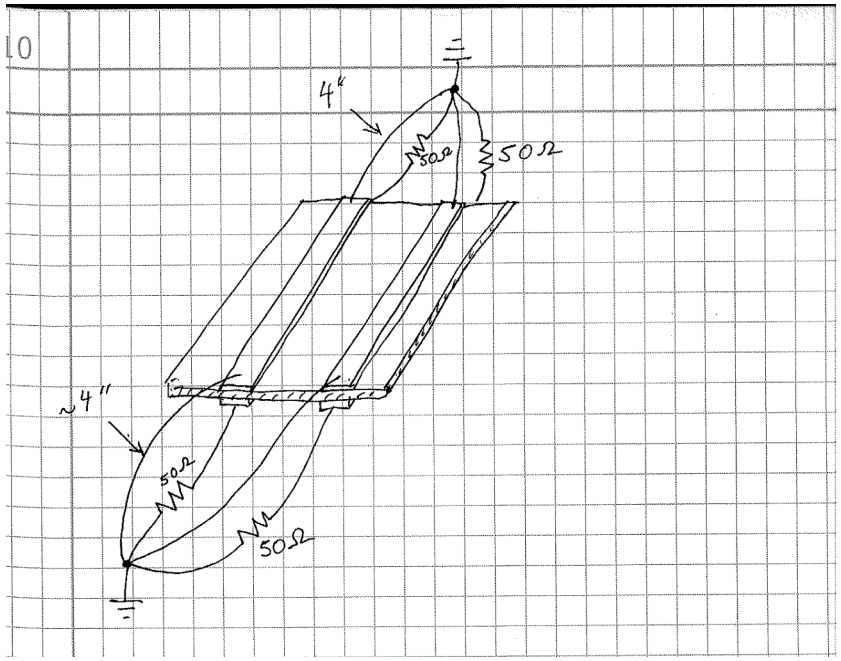
**Is really bad on the SiAB**

**Also bad on demountable**



# Ground loops




**Many potential ground loops.**

**An inductor on the bottom-most HV connection (capacitive coupling between MCP and HV) greatly reduced the oscillations in the 8” and 33mm.**

**But, the demountable and the scope-in-a-box have many new, not yet understood problems.**

**We need a day (plus follow-up) with an expert.**

# SuMo…What's next

- Ran into difficulty removing the solder connections from the tile. May have damaged the RF properties. Checked with the spectrum analyzer. Most channels look good.
- New setup is nonetheless finished and pumping.
- Achieved vacuum in the mid e-6 range without bakeout.
- Leak check found a small leak. Opened and still have a leak…working on this
- Goal for this month is to test one demountable with the fully integrated electronics.
- Next month to add a second tile.